



Appendix D

DRAINAGE AND UTILITIES PLAN

Appendix D

DRAINAGE AND UTILITIES PLAN

Master Plan
Ryan Airfield

INTRODUCTION

The Ryan Airfield Project encompasses approximately 1,600 acres of land. It is located within Sections 11, 12 and 13 of Township 15 South, Range 11 East, and Section 7 of Township 15 South, Range 12 East, Pima County, Arizona. The project is located North of Ajo Highway (State Route 86) and is bounded west by Postvale Road and north by Park Road. The airport is owned by the City of Tucson and operated by the Tucson Airport Authority. Access to the site is possible via Ajo Highway (State Route 86) or Valencia Road.

This report has been prepared to summarize existing utilities located at Ryan Airfield and to conceptually address future utility needs for proposed development onsite. Utilities include: electricity, gas, telephone, sewer, water as well as drainage structures. The chosen alternative for future development at Ryan Airfield is based on Chapter 5 of the Airport Master Plan, dated May 27, 1999, developed by Coffman Associates, Inc.

The information provided within this report was drawn from the gathering of existing available documents and site reconnaissance. Referenced information includes plans from Tucson Water for existing water supply, Trico Electric Cooperative, Inc. and Tucson Electric Power Company for power line locations and plans from Southwest Gas Corporation for gas lines location. Parsons Brinckerhoff "Ryan Airfield Airport-Wide Basin Study Conceptual Drainage Development Plan," April, 1992 and "Taxiway Reconstruction, Detention Basin Construction, Wings Apron Expansion and Waco Way Extension" were used to assess existing drainage structures as well as "Grading and

Drainage Plans" from the Ryan Airfield Airport Improvement Program, prepared by Cella Barr Associates, Inc., 1992. Existing on-site sanitary sewer locations were depicted using a Sanitary Sewer Study prepared by Parsons Brinckerhoff, dated June, 1996.

In addition, drawings were provided by the Tucson Airport Authority, which depict existing onsite electricity, gas, sewer, telephone and water. These plans were hand drawn by the Tucson Airport Authority staff.

Many alternatives were considered for future development at the airport. The previously mentioned Airport Master Plan developed by Coffman Associates, Inc. outlined the chosen alternative. Two categories of alternatives are addressed, airfield and landside. Proposed improvements for the airfield are:

1. Extension of the primary runway (6R-24L) from 5,500 feet long and 75 feet wide to 8,300 feet in length and 100 feet wide.
2. An additional taxiway parallel to Runway 6R-24L, located 452 feet south of the runway centerline.
3. Realignment of Taxiway 2.
4. Relocation of the threshold for Runway 6R-24L further to the west.
5. Installation of a simplified short approach lighting system (SSALS).
6. Extension of Taxiway 5 which will connect the east end of Runway 6L-24R with the terminal area.
7. Possible extension of Runway 15-33 to 4,800 feet to the north.
8. Addition of a partial taxiway between Taxiway D and Runway 15-33.
9. Addition of a helipad.

Future improvements proposed for the landside include:

1. Implementation of Airfield Drive as the primary entrance to the site.
2. New aprons and a terminal/administration building.
3. Additional hangar development.
4. Dormitory and campus for flight training or office space.
5. Expansion of the flight training facility in the southwest corner.
6. Addition of a self-serve fuel island.
7. New terminal area east of Taxiway 4.
8. Additional parking, additional T hangar.

It is the Tucson Airport Authority's intention to acquire additional land in the near future. A total of approximately 475 acres is planned to be added to the existing property boundary. The addition is concentrated mainly to the north of the existing airport property line. Future land acquisition is delineated in Figure 1, Proposed Airport Layout Plan.

Information presented herein is based on current, available data and regulatory agency requirements to the level of investigation and research as directed by the Airport Authority and specified in the Agreement Between Client and CBA. This report is not a detailed hydrologic/hydraulic analysis. Such an analysis for the subject property/project would be required as part of the design package prior to the development or construction on the property, including appropriate agency review and approvals. Such an analysis would include, but not be limited to, accurately identifying existing and potential hydrologic conditions, flooding limits, erosion hazard potential and limits, etc.; and preparing or conducting hydraulic analyses and designs for drainage structures/facilities, construction cost estimates, agency permits, etc.

DRAINAGE

The "Airport-Wide Basin Study Conceptual Drainage Development Plan," dated April, 1992, identifies seven upstream watersheds impacting the subject property's southern boundary line. Offsite runoff is conveyed north in a network of braided channels and sheet flow to Ajo Highway. Runoff enters the site via existing culverts located under Ajo Highway. It is then conveyed onsite in a northerly manner via existing earthen channels and sheet flow. Onsite, a portion of the site gently slopes to the northeast as the remainder of the parcel generally slopes to the northwest (see Figure 1).

The study area is located within a Federal Emergency Management Agency (FEMA) mapped special flood hazard area (100-year floodplain) per the current Flood Insurance Rate Map (FIRM), Community Panel No. 04019C-2200K, dated February 8, 1999 (see Figure 2 included herein). The parcel is located within Zone AO with associated depth of flow of 1 foot as well as Zone A (Special Flood Hazard Area, no base flood elevations determined).

Proposed airfield and landside development will impact the existing drainage conditions at Ryan Airfield. Landside development will mostly impact the eastern portion of the site. Relocation of an existing dike was presented in the Airport Master Plan and the proposed location is shown on Figure 1. Existing and potential future drainage issues associated with the removal or relocation of this existing dike for potential future development are presented herein.

The existing dike is located approximately 700 feet east of Airfield Drive, just north of Ajo Highway, in Section 7, Township 15 South, Range 12 East, Pima County, Arizona. A total of three culvert crossings are located east of the aforementioned dike at the south property line (Ajo Highway). The westernmost culvert crossing is located approximately 1,150 feet east of the dike along Ajo Highway and consists of seven 10' x 5' x 58' CBCs. The 100-year peak discharge associated with this culvert crossing is approximately 3,300 cubic feet per second (cfs) (per the latest Arizona Department of Transportation (ADOT) Plan and Profile, dated May, 1988), with a total capacity of approximately 5,950 cfs (per Parsons Brinckerhoff Conceptual Drainage Development Plan, April, 1992). Therefore, the runoff associated with the 100-year storm would be

conveyed across the highway via the culverts onto the parcel. This runoff then flows across the site via an unnamed wash and sheet flow.

The second culvert crossing consists of two 24-inch CMPs and is located approximately 2,000 feet east of the existing dike with a total capacity of approximately 60 cfs. The last culvert crossing is located approximately 3,300 feet east of the existing dike and consists of five 10' x 6' x 51.5' CBCs which have a total capacity of approximately 4,500 cfs. The drainage pattern for these culverts is similar to the one described above.

Per the final Parsons Brinckerhoff "Airport-wide Basin Study Conceptual Drainage Development Plan," the 100-year peak discharge conveyed onto the property, east of the existing dike, is approximately equal to 7,000 cfs. Therefore, it is apparent that the complete removal of the dike is not a feasible alternative to existing hydrologic conditions governing onsite. It appears that the dike was constructed to redirect the flow away from the main runway and taxiways. The removal of the dike would create sheet flooding across the eastern portion of Ryan Airfield, potentially damaging existing infrastructures.

However, per the aforementioned 1992 Parson's Brinckerhoff study, the possibility of channelizing the runoff within the property boundary and moving the existing dike had been considered. Two earthen channels were proposed on the eastern portion of the airfield. The proposed channels are hydroseeded with low-growth vegetation (grasses). Earth spreader dikes and channel widening were proposed to disperse and spread the channelized flows prior to leaving the site. Within Alternatives 1 and 2, the proposed channel cross-sections have capacity to convey runoff associated with a 25-year storm event while Alternative 3 proposed channel cross-sections have capacity to convey the 5-year storm event. Channel cross-sections include 1 foot of freeboard and channel locations are situated at the outlets of existing culverts (see Exhibit 6, Existing and Proposed Drainage Structures). Channel 4 is located at the outlet of the existing seven 10' x 5' CBCs with capacity to convey runoff from the 25-year storm event (3,342 cfs within Alternatives 1 and 2). Channel 5 is located at the outlet of the five 10' x 6' CBCs with capacity to convey 1,324 cfs which is also associated with the 25-year storm event. Within Alternative 3, the proposed channel cross-sections have capacity to convey 1,298 cfs for Channel 4 and 568 cfs for Channel 5, which corresponds to the 5-year storm event.

Apparently, construction of the 25-year capacity channels (Alternatives 1 and 2) may also mitigate the impacts to the 100-year floodplain from relocating the dike. However, relocation of the dike would require a detailed hydraulic/hydrologic study in order to assess the impacts on adjacent properties and identify additional drainage issues. Per local criteria, encroachment into the existing 100-year floodplain is limited to a 0.1-foot rise in water surface elevation.

One of these additional drainage issues is the presence of Pima County-designated riparian habitat onsite. The aforementioned unnamed washes have been classified as

Riparian Habitat Wash (classified Xeroriparian B), and a mitigation plan is required if the wash is altered from existing conditions. See included Figure 3 (Riparian Habitat Location, East of Existing Dike). If development is proposed within the washes, Pima County ordinance requires rational explanation that no other options are available beyond the proposed encroachment into the wash.

In addition, the unnamed washes are jurisdictional waterways under the Clean Water Act 404 Permit program issued by the U.S. Army Corps of Engineers (ACOE). All proposed construction activities within the jurisdictional limits, as determined by the ACOE, must meet the individual conditions of a specific nationwide permit, or an application for an individual permit is required.

In summary, the relocation of the dike would more than likely require the following tasks to satisfy the Pima County Floodplain Management Section and Army Corps of Engineers:

- Provide the minimum finished floor elevation (FFE) for the proposed structures. The FFE will need to be set at a minimum 1 foot above the 100-year water surface elevation.
- FEMA Letter of Map Revision (LOMR) for any structures constructed within the Special Flood Hazard Areas.
- Provide the hydrologic/hydraulic computations showing the impact on the existing water surface elevation.
- Provide a minimum building setback of 100 feet from the top of bank of existing washes for Erosion Hazard Setback.
- Application for a 404 Permit if any activity discharges dredged or fill material into jurisdictional areas.
- A mitigation plan to satisfy the Riparian Habitat Wash Ordinance if the wash is altered from the existing conditions.

Future encroachment into the area east and west of the existing dike presents administrative/ regulatory, environmental and technical-oriented challenges which require detailed investigation.

Proposed channels and culverts location on Exhibit 6 are based on Alternative 2 of the aforementioned 1992 Parsons Brinckerhoff report. However, consideration to the object free area (which extends 1,000 feet east of Runway 6R/24L) was omitted in the choice of channel alignment on the eastern portion of the site. Therefore, the northern portion of the proposed alignments for channel 4 and 5 was shifted. The downstream reach of the channels were conceptually relocated farther east, within the subject property, to respect clearance for the object free area. Further analysis will need to be performed to insure that these alignments are viable.

Additionally, airfield development will impact existing drainage conditions onsite. However, due to the location of the proposed airfield development, impacts will mostly

occur on the western portion of the site. Again, a more detailed study assessing drainage issues associated with the airfield development will need to be performed. Similar concerns are anticipated on the western portion (FFE 1 foot above the 100-year water surface elevation, FEMA LOMR, 404 Permit, mitigation plan).

The "Airport-Wide Basin Study Conceptual Drainage Development Plan" addressed the possibility of channelizing flow on the western portion of the site. Proposed channel locations are presented in Exhibit 6. Channels are also proposed to be hydroseeded with low-growth vegetation (grasses) with earth spreader dikes and channel widening to disperse the flow prior to leaving the site. Proposed drainage improvements will need to be designed in a manner that will mitigate impacts to downstream properties.

Moreover, considerations of possible landside and airfield development of the airport as far east as taxiway B6 were made. A road extending approximately 1,500 feet to the east of the proposed road along Ajo Highway, and shifting north to the east end of existing taxiway B6 was considered as a possible option for future development. A channel adjacent to this road was considered as a means to carry runoff to the north of the site.

An estimated 30 acres of land could be recovered from this design. It is estimated that this channel construction could increase the construction cost detailed in the Parsons Brinckerhoff study by \$500,000. However, such an option may not be feasible at any cost. Construction of such a "collecting" drainageway would have significant impacts to the upstream water characteristics, as well as the onsite riparian habitats. A detailed study would be required explore the viability of this alternative.

SANITARY SEWER

Existing sewage disposal is by septic system. The existing system consist of eight onsite individual septic systems as well as one community septic system (see Exhibit 3, Existing and Proposed Sewer). These systems were reported to be in good condition, per the 1996 Parson Brinckerhoff Sanitary Sewer Study. Soils conditions were found to be suitable for utilization of a sanitary septic system.

The disposal of sewage east of onsite topographic ridge line is provided predominantly by the community septic system. The western portion is mostly provided through the individual septic systems. At the completion of the sanitary sewer study, the remaining life of the 12,500-gallon tank of the community septic system was projected to be 37 years and it was estimated that approximately 30 acres of future development could be added to the collective system. However, depending on the density of the development proposed, this information could change with respect to the 30 acres of additional use. Septic tank and leach field will also need to be evaluated each time a sewer connection is added.

Four alternatives were presented in the previously mentioned report to address future sewer needs. They included:

1. Individual septic tanks
2. Connection to the existing Snyder Hill Treatment Facility
3. Community septic tank/leach field system
4. On-airport treatment facility

The first alternative consisted of maintaining the existing individual septic systems for each leasehold. The connection to the Snyder Hill Facility (Alternative 2) consisted of connecting directly to the treatment facility or connecting to the existing 21-inch sewer main. The third option considered was to build a community sewage system throughout the airfield, identical to the system currently in place for a portion of the airport. The last alternative studied the possibility of constructing an onsite sewage disposal system.

The following issues need to be considered in the evaluation of sewer alternatives:

1. Right-of-way
2. Environmental permitting requirements
3. Construction phasing flexibility
4. System capacity utilization

Advantages and disadvantages of the alternatives are summarized in the following table. The preferred option of the Sanitary Sewer Study consisted of the community septic tank/leach field system (Alternative 3).

Summary of Advantages and Disadvantages for Sewer Alternatives		
	Advantages	Disadvantages
Alt. 1	Construction phasing flexibility. Developer is responsible for installation. Permitting is minimal.	Low capacity utilization.
Alt. 2	High utilization of available capacity. Eliminates installation of individual septic system and its maintenance.	High right-of-way and construction costs. Low construction phasing. Environmental permit requirements.
Alt. 3	Maximize system capacity. Construction phasing flexibility. High land availability.	Potentially developed property needs to be dedicated to the system.
Alt. 4	High utilization capacity. Eliminates maintenance of individual septic system.	Permitting extensive. Low potential source for disposal of effluent. High maintenance, requires operator and constant monitoring and is expensive to operate. High construction costs due to need for closed system. Potentially developed property needs to be dedicated to the system.

Most likely, the sewage disposal will continue to be by septic system (individual or collective system). However, alternatives considered above are still relevant to this project. The possibility of connecting to the existing 21-inch which is located 1,250 feet to the northeast of the airport and discharges into the Snyder Hill Treatment Facility is still a feasible alternative. However, it is not an economical alternative. Each phase of the project will need to be evaluated on a case-by-case basis. In addition, the "Sanitary Sewer Study" recommended that any new leach fields should not be placed adjacent to existing airfield pavement.

POWER

Existing and proposed electric power lines are presented in Exhibit 1. Electric lines are depicted in accordance with the drawing provided by Tucson Electric Power Company, Trico Electric Cooperative and information from the Tucson Airport Authority maps. However, site reconnaissance revealed that electric lines at Aviator Lane shown as located overhead on the Tucson Electric Power Company and the T.A.A.

maps, are no longer located overhead. It has been assumed that these lines have been relocated underground.

Tucson Electric Power Company was contacted concerning future development at Ryan Airfield. According to Frank Kilpatrick, TEP does not have a master plan for anticipated developments. The design is done on a case-by-case basis. A copy of the Airport Master Plan should be submitted to TEP for comment prior to proceeding with future development.

GAS

Southwest Gas Corporation, Inc. serves Ryan Airfield. The existing and proposed gas lines are depicted on Exhibit 2, Existing and Proposed Gas. Information relating to location of existing gas was drawn from the Southwest Gas Corporation maps as well as drawings provided by the T.A.A. staff. This corporation does not have a master plan for future development. A copy of the Airport Master Plan should be submitted to this company as well, for comment prior to proceeding with any future development.

TELEPHONE

US West provides Ryan Airfield with telephone services. The existing and proposed telephone lines are depicted on Exhibit 4. Information relating to location of existing lines was provided solely by the Tucson Airport Authority and were depicted according to the T.A.A. maps. In fact, it seems that for technical reasons, US West does not provide the public with maps depicting location of existing services. A copy of the Airport Master Plan should be submitted to US West for comment on proposed telephone lines prior to proceeding with development.

WATER

The existing system is being served by dead end 12" and 8" mains. It is proposed to loop the system with the proposed extensions. The existing supply is from Tucson Water transmissions mains and wells as follows:

- Existing City of Tucson 42" water transmission main along Ajo Way and Valencia Road.
- Existing City of Tucson Wells AV9 and AV8 (or AV27) with a production of 1,000 GPM (gallons per minute) and 700 GPM each.

These wells and the 42" water main are located in the COT Pressure Zone "B", Highwater Elevation 2,600, Service Boundaries Elevation 2,416 and 2,490 (80 and 48

pound per square inch (psi)). Site Average Elevation is 2,420. Estimated average pressure at the site is approximately 78 psi.

AVAILABLE FLOW:

With the proposed looping, it is estimated that 2,500 GPM will be available for fire flow. Domestic flow is also estimated to be available in addition to the Fire Flow (See included map for proposed looping of the existing mains). Flows are based on previous hydrant tests provided by TAA.

There is currently a problem with residual pressure dropping to 10 psi or less with the present distribution lines configuration. The minimum allowed by A.D.E.Q. is 20 psi. It is estimated at this point that construction of the proposed looping will also solve this problem. As development occurs, the proposed loops will have to be completed to provide the required fire flow and system distribution pressures.

Mr. Larry Mulhern from Tucson Water was contacted to inquire regarding future expansion in the Ryan Airfield area. It appears that Tucson Water has a plan for the southwest area but it is very schematic. However, this plan does not introduce new water lines on the airport property. Tucson Water growth is based on new development. Again, proposed addition should be presented to Tucson Water as soon as possible.

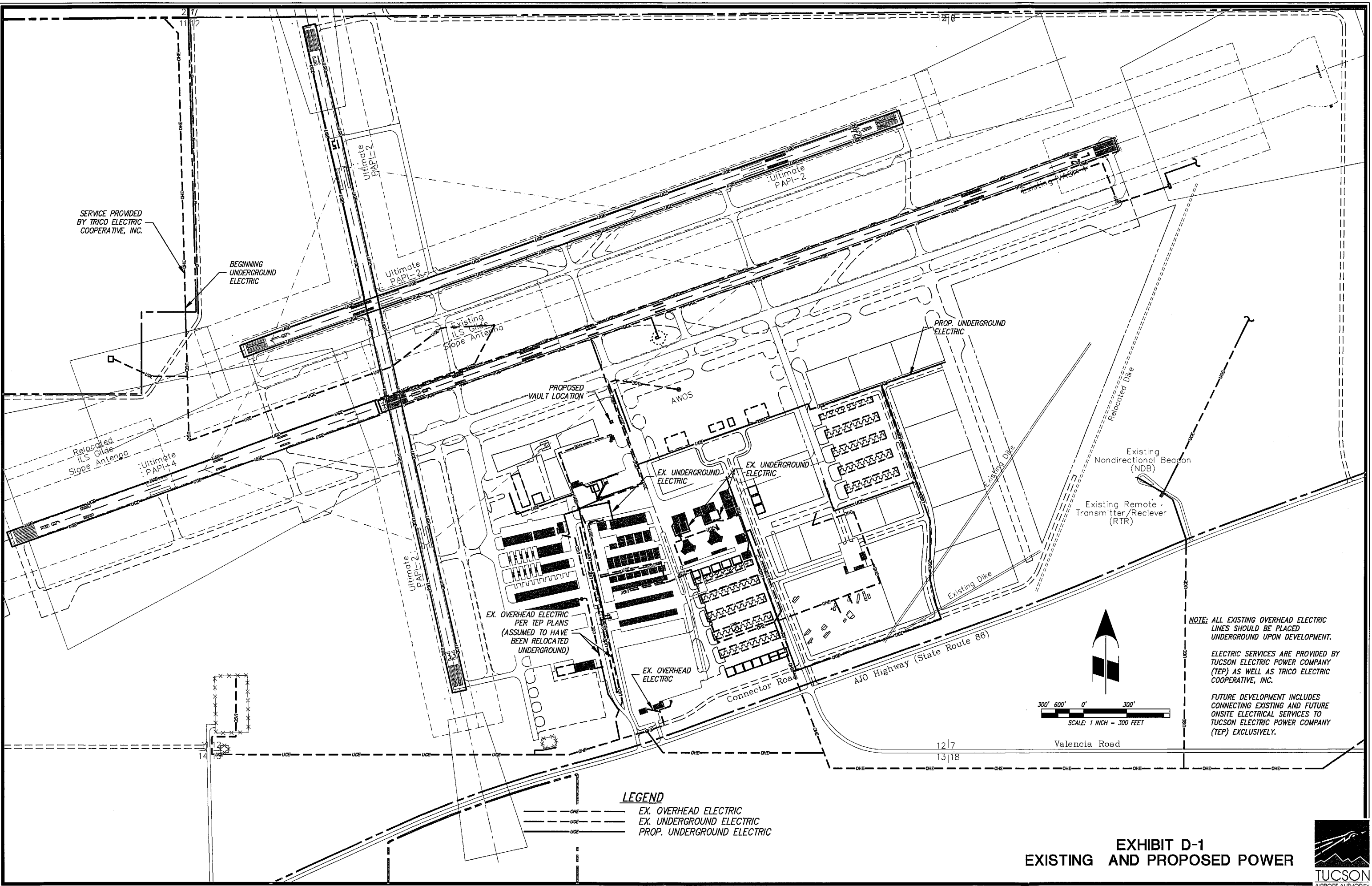
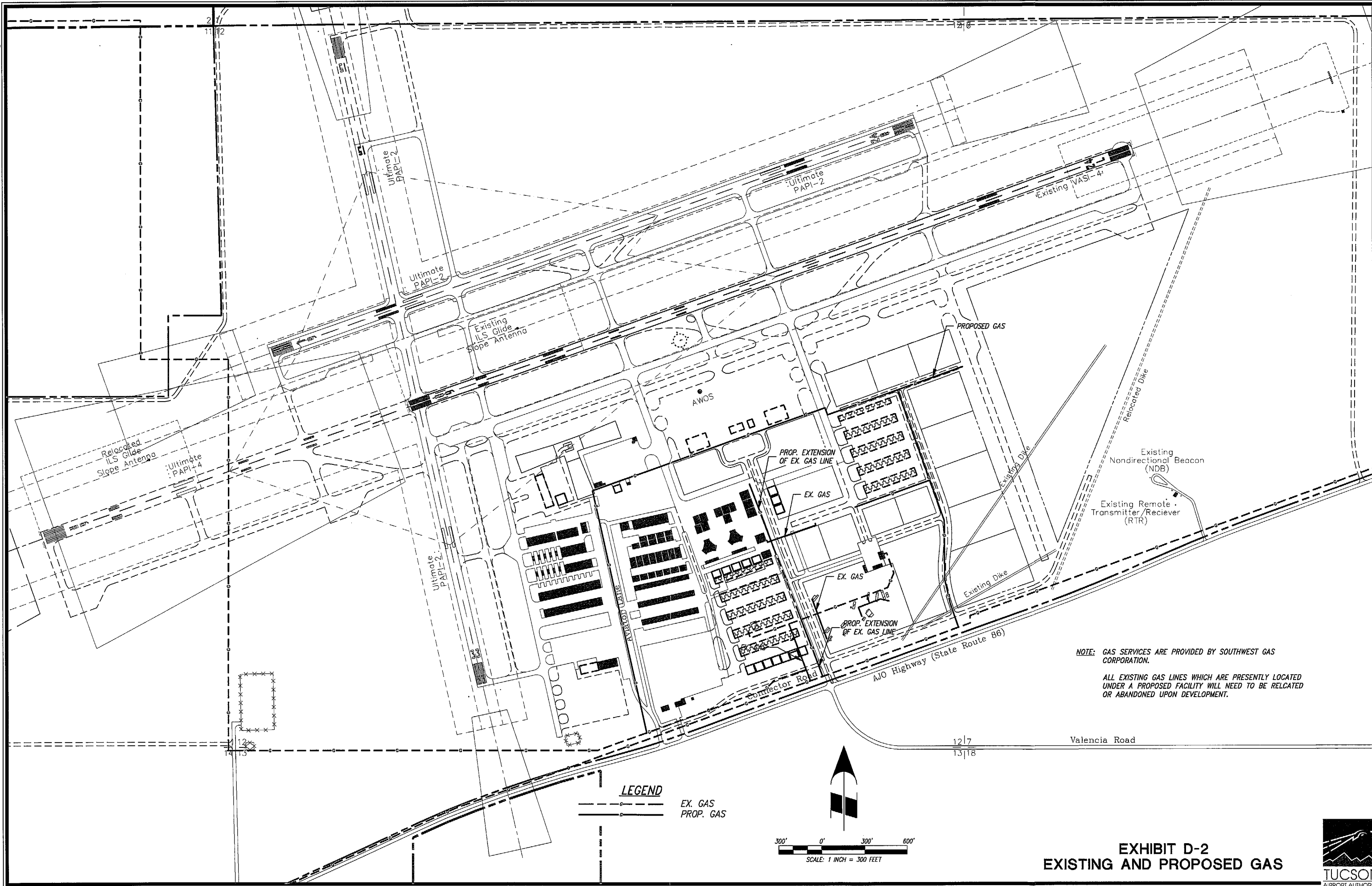


EXHIBIT D-1
EXISTING AND PROPOSED POWER





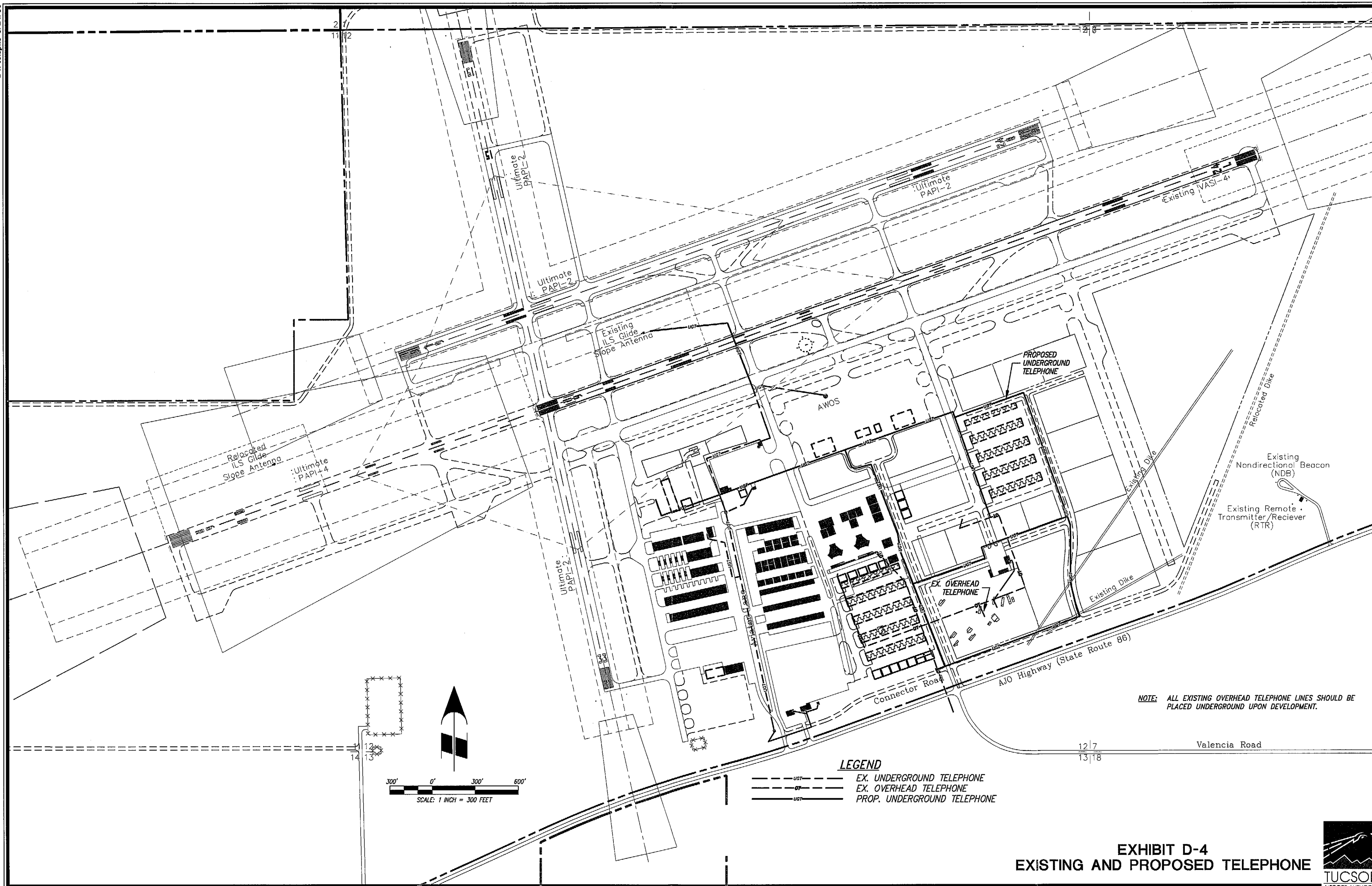
**EXHIBIT D-2
EXISTING AND PROPOSED GAS**

THE DIKE AS PROPOSED BY THE PARSONS BRICKNERHOFF
"AIRPORT-WIDE BASIN STUDY" CONCEPTUAL DRAINAGE DEVELOPMENT
PLAN, APRIL 1992 WILL NEED TO BE IN PLACE FOR CONSTRUCTION
OF THE PROPOSED LEACHING FIELD.

_____ 4" S _____ EX. 4" SEWER
 _____ 6" S _____ EX. 6" SEWER
 _____ 8" S _____ EX. 8" SEWER
 _____ 8" S _____ PROP. 8" SEWER
 _____ EX. SEPTIC TANK

EXHIBIT D-3
EXISTING AND PROPOSED SEWER





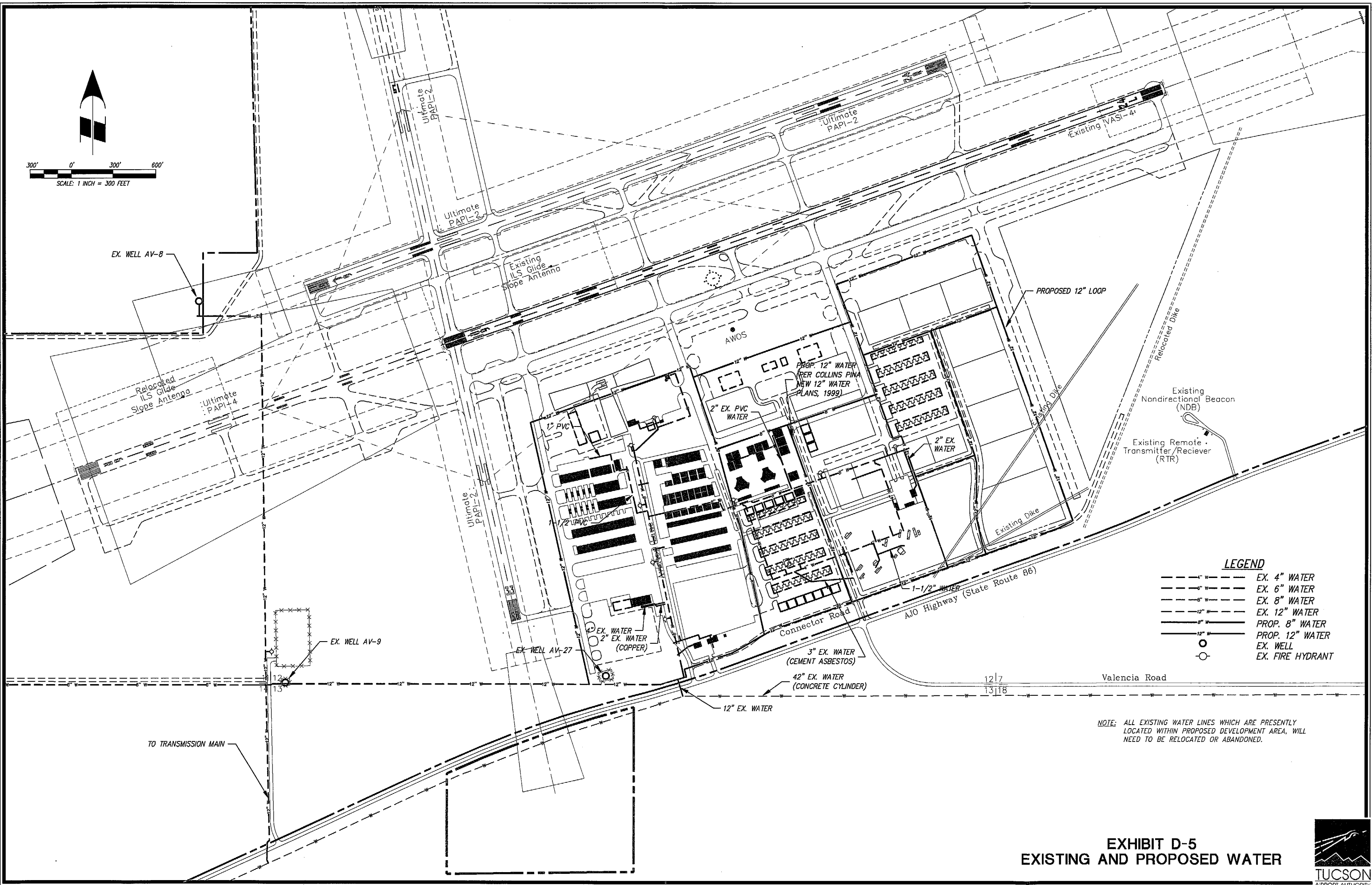


EXHIBIT D-5
EXISTING AND PROPOSED WATER



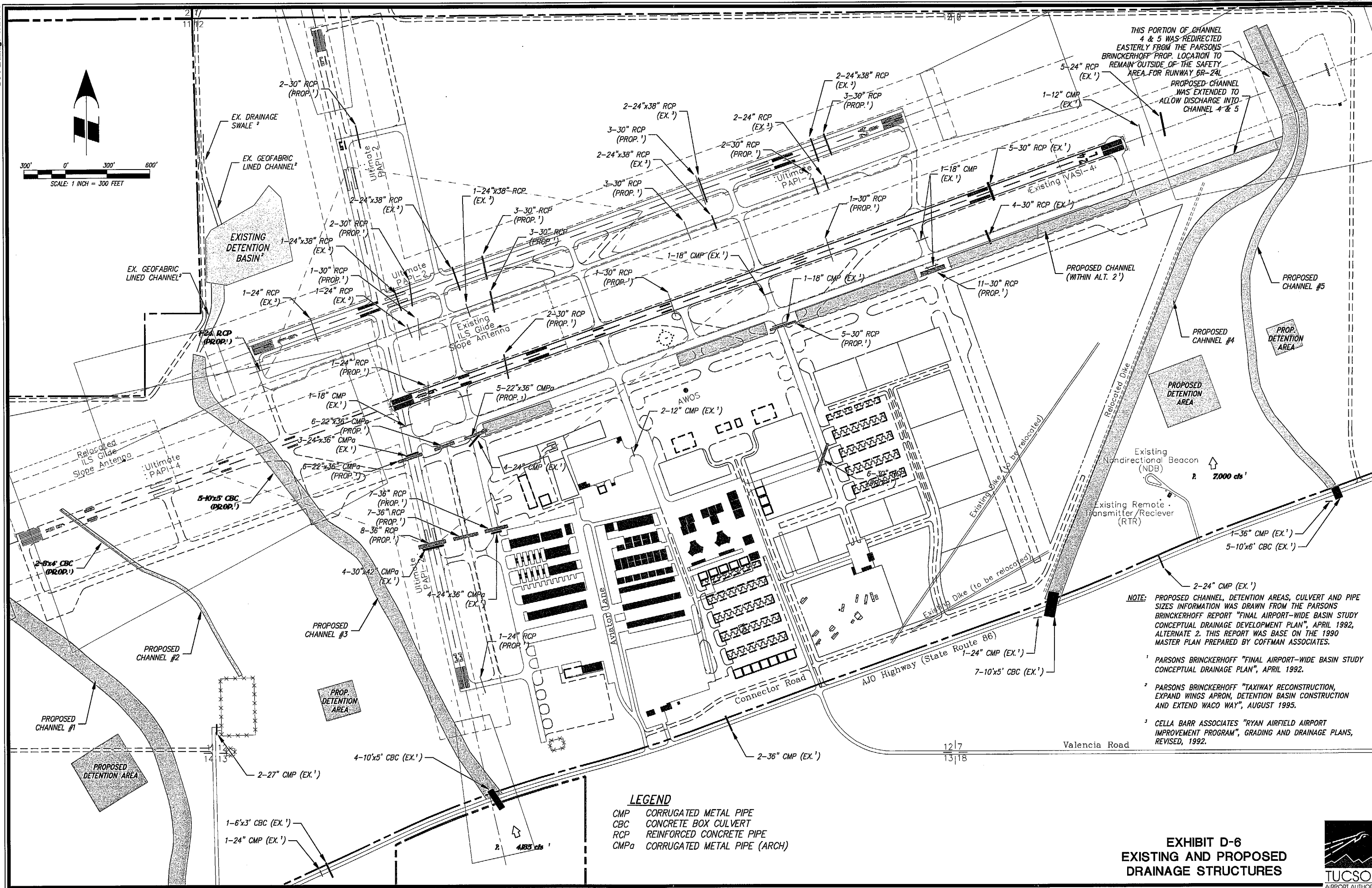


EXHIBIT D-6
EXISTING AND PROPOSED
DRAINAGE STRUCTURES



KANSAS CITY
(816) 524-3500

237 N.W. Blue Parkway
Suite 100
Lee's Summit, MO 64063

PHOENIX
(602) 993-6999

11022 N. 28th Drive
Suite 240
Phoenix, AZ 85029